

PATENT ABSTRACTS OF JAPAN

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(21)Application number : 2001-346338 (71)Applicant : KOREA ELECTRONICS TELECOMMUN

(22)Date of filing : 12.11.2001 (72)Inventor : CHA JAE SANG

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(54) DEVICE AND METHOD FOR GENERATING THREE-DIMENSIONAL SPREAD CODE HAVING ZERO CORRELATION PERIOD

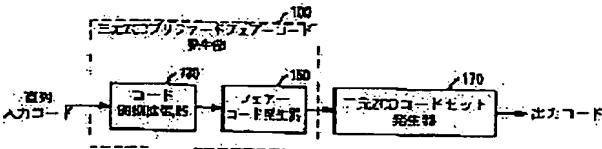
(57)Abstract:  
PROBLEM TO BE SOLVED: To provide a device and method for generating a three-dimensional spread code having a zero correlation period and a computer-readable recording medium for recording a program to realize the method.  
SOLUTION: The three-dimensional spread code generating method applies to a three-dimensional code generator with a zero correlation period includes a first step of a three-dimensional zero correlation period preferred fair code to maintain a zero correlation characteristic of an extended code of (0.75N+1) chips

resulting from extending a code period of a code whose period is N chip (N is a natural number) and a second step of applying chip shift to the generated three-dimensional zero correlation period preferred fair code to generate many three-dimensional zero correlation period preferred fair code sets with a zero correlation characteristic of (0.75N+1) chips or below.

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## CLAIMS

### [Claim(s)]

[Claim 1] It sets to the 3 yuan diffusion code generating approach applied to the 3 yuan diffusion code (Ternary spreadingcode) generator which has the zero correlation section, and a period is N chip (N). The 1st step which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip ( $0.75N+1$ ) is maintained, Said generated 3 yuan zero correlation section PURIFADOFEA code The 3 yuan diffusion code generating approach of having the zero correlation section characterized by having the 2nd step which generates the 3 yuan zero correlation section code set of a large number which are made carrying out a chip shift (CHIP SHIFT), and have a zero correlation property below a chip ( $0.75N+1$ ).

[Claim 2] The 3rd step in which said 1st step forms a basic diffusion code from early basic METORIKKUSU. The inside of the 3 yuan zero correlation section PURIFADOFEA code which a period is extended and has the zero correlation property of a chip ( $0.75N+1$ ) with the period beyond a predetermined multiple based on said formed basic diffusion code. The even number term of the 4th step which generates 3 yuan diffusion code of one of the two, and said generated code of one of the two is reversed. The 3 yuan diffusion code generating approach of having the zero correlation section according to claim 1 characterized by including the 5th step which generates the 3 yuan diffusion code corresponding to the diffusion code generated at said 4th step.

[Claim 3] Said generated 3 yuan diffusion code is the 3 yuan diffusion code generating approach of having the zero correlation section according to claim 1 or 2 characterized by being used as an early code for synchronous prehension connected with the matched filter.

[Claim 4] Said generated 3 yuan diffusion code is the 3 yuan diffusion code generating approach of having the zero correlation section according to claim

1 or 2 characterized by being used for multiplexing of each channel, and the chip synchronization between codes in a code division multiplex connection (Code Division Multiple Access:CDMA) system.

[Claim 5] Said generated 3 yuan diffusion code is the 3 yuan diffusion code generating approach of having the zero correlation section according to claim 1 or 2 characterized by being used for the hard flow link of a cellular (Cellular) system, enabling employment of a system which does not need the synchronization between codes, being used for a forward direction link, and decreasing the multi-pass by the semi-synchronous employment section.

[Claim 6] Said generated 3 yuan diffusion code is the 3 yuan diffusion code generating approach of having the zero correlation section according to claim 1 or 2 characterized by generating an extended matrix and extending a code through each line or the line which reversed a part of sign of each of that line.

[Claim 7] Said generated 3 yuan diffusion code is the 3 yuan diffusion code generating approach of having the zero correlation section according to claim 1 or 2 characterized by being used for the matched filter of the low-power mold from which the circuit of the addition connected with the zero tab multiplier used as half [ of a tab multiplier ] and the multiplication section was removed when embodying the matched filter for the back diffusion of electrons in hardware.

[Claim 8] It sets to the 3 yuan diffusion code generating unit which has the zero correlation section, and a period is N chip (N). The 3 yuan autocorrelation section PURIFADOFEA code generating means for generating the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip ( $0.75N+1$ ) is maintained, The chip shift of the 3 yuan zero correlation section PURIFADOFEA code generated by the autocorrelation section PURIFADOFEA code generating means is carried out. [ of said 3 yuan ] ( $0.75N+1$ ) The 3 yuan diffusion code generating unit which has the zero correlation section characterized by having a 3 yuan autocorrelation section code set generating means for generating the 3 yuan zero correlation section code set of a large number which have a zero correlation property below a chip.

[Claim 9] Said 3 yuan, an autocorrelation section PURIFADOFEA code generating means The inside of the 3 yuan zero correlation section PURIFADOFEA code which a period is extended and has a period beyond a predetermined multiple based on the basic diffusion code formed from early basic METORIKKUSU. A code period escape means to generate 3 yuan diffusion code of one of the two, The even number term of one of the two's diffusion code generated by the extended means of said code period is reversed. With said code period escape means The 3 yuan diffusion code

generating unit which has the zero correlation section according to claim 8 characterized by including a fair code generating means to generate the 3 yuan diffusion code corresponding to the generated code.

[Claim 10] Said generated 3 yuan diffusion code is a 3 yuan diffusion code generating unit which has the zero correlation section according to claim 8 or 9 characterized by being used as an early code for synchronous prehnension connected with the matched filter.

[Claim 11] Said generated 3 yuan diffusion code is a 3 yuan diffusion code generating unit which has the zero correlation section according to claim 8 or 9 characterized by being used for multiplexing of each channel, and the chip synchronization between codes in a code division multiplex connection (Code Division Multiple Access:CDMA) system.

[Claim 12] Said generated 3 yuan diffusion code is a 3 yuan diffusion code generating unit which has the zero correlation section according to claim 8 or 9 characterized by being used for the hard flow link of cellular system, enabling employment of a system which does not need the synchronization between codes, being used for a forward direction link, and decreasing the multi-pass by the semi- synchronous employment section.

[Claim 13] Said generated 3 yuan diffusion code is a 3 yuan diffusion code generating unit which has the zero correlation section according to claim 8 or 9 characterized by generating an extended matrix and extending a code through each line or the line which reversed a part of sign of each of that line.

[Claim 14] Said generated 3 yuan diffusion code is a 3 yuan diffusion code generating unit which has the zero correlation section according to claim 8 or 9 characterized by being used for the matched filter of the low-power mold from which the circuit of the addition and the multiplication section which are connected with the zero tab multiplier used as half [ of a tab multiplier ] was removed when embodying the matched filter for the back diffusion of electrons in hardware.

[Claim 15] A period is N chip (N) to the 3 yuan diffusion code generating unit equipped with the processor which has the zero correlation section. The 1st function which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip ( $0.75N+1$ ) is maintained. The chip shift of said generated 3 yuan zero correlation section PURIFADOFEA code is carried out ( $0.75N+1$ ) The record medium which can be read by computer which recorded the program for realizing the 2nd function which generates the 3 yuan zero correlation section code set of a large number which have a zero correlation property below a chip.

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#### DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the record medium which can read by the computer which recorded the program for realizing a diffusion code generating unit and its approach, and said approach of 3 yuan which has the zero correlation section which enabled it to maintain the number of many diffusion codes, having the zero correlation property which intersects perpendicularly about a diffusion code (Ternary spreading code) generator and its approach in the time-amount section more large in a detail.

[0002]

[Description of the Prior Art] Generally in a code division multiplex connection (Code Division Multiple Access: CDMA) system, the channel which faces to a mobile station (Mobile Station) from a base station (Base Station) is called forward direction link (down-link), and the channel which goes to a base station from a mobile station is called hard flow link (up-Link).

[0003] It sets to said CDMA system and they are each mobile station (Mobile Station) and a base. Although a station (Base Station) is a diffusion code which has a rectangular property and the Walsh code (Walsh Code) and the ADAMARU code (Hadamard Code) are used, if such a rectangular property of a rectangular code is maintained only when the synchronization between diffusion codes is only established, and a synchronization is not established, a rectangular property has the demerit in which it breaks. Therefore, since the code which intersects perpendicularly only under the conditions on which the code synchronization was established according to such demerit should be used, the interference (co-channel interference) phenomenon between the user channels which adjoin by the multiple access (multiple access) in a hard flow link was generated and the rectangular property broke by the delay wave by multi-put, there was a trouble that a system characteristic deteriorated.

[0004] Therefore, research for finding the diffusion code in which a fixed time amount and rectangular cross property continues, and is maintained has been

done briskly, moreover, recently -- a rectangular gold code -- cooperating -- although a diffusion code called constituted QS (OG-r) is proposed, since the number of the codes which can also secure this if the zero correlation section becomes large decreases extremely -- a part for a code -- there was a trouble that it could not contribute to multiplexing depended comparatively greatly.

[0005] then, the duality which the number of codes can secure from QS (OG-r) while it has the zero correlation section of the maximum (0.5N+1) chip, in order to solve such a trouble -- although the ZCD code is proposed, this also has the limitation that the maximum zero correlation section is a chip (0.5N+1).

[0006]

[Problem(s) to be Solved by the Invention] For this invention, it is proposed in order to solve the aforementioned conventional trouble, and a period is N chip (N). The 3 yuan diffusion code generating unit which has the zero correlation section it was made to generate the diffusion code from which the side lobe and cross-correlation value of the peak circumference of an autocorrelation value become zero between the fixed time amount sections below a chip (0.75N+1) to the code of the natural number, and its approach. The purpose is in offering the record medium which can be read by computer which recorded the program for realizing said approach.

[0007]

[Means for Solving the Problem] In order to attain the above purposes, this invention it sets to the 3 yuan diffusion code generating approach applied to the 3 yuan diffusion code (Ternary spreading code) generator which has the zero correlation section, and a period is N chip (N). The 1st step which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip (0.75N+1) is maintained, it is characterized by having the 2nd step which generates the 3 yuan zero correlation section code set of a large number which are made to carry out the chip shift (CHIP SHIFT) of said generated 3 yuan zero correlation section PURIFADOFEA code, and have a zero correlation property below a chip (0.75N+1).

[0008] Moreover, for this invention, it sets to the 3 yuan diffusion code generating unit which has the zero correlation section, and a period is N chip (N). The 3 yuan autocorrelation section PURIFADOFEA code generating means for generating the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip (0.75N+1) is maintained, The chip shift of the 3 yuan zero correlation section PURIFADOFEA code generated by the autocorrelation section PURIFADOFEA code generating means is carried out. [ of said 3 yuan ] (0.75N+1) It is characterized by having a 3 yuan autocorrelation section code set generating means for generating the 3 yuan zero correlation section code set of a large number which have a zero correlation property below a chip.

[0009] Moreover, for this invention, a period is N chip (N) to the 3 yuan diffusion code generating unit equipped with the processor which has the zero correlation section. The 1st function which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip (0.75N+1) is maintained. The chip shift of said generated 3 yuan zero correlation section PURIFADOFEA code is carried out. (0.75N+1) The record medium which can be read by computer which recorded the program for realizing the 2nd function which generates the 3 yuan zero correlation section code set of a large number which have a zero correlation property below a chip is offered.

[0010]

[Embodiment of the Invention] One desirable example concerning this invention is explained to a detail, referring to the attached drawing hereafter.

[0011] Drawing 1 thru/or drawing 3 are the block block diagrams of one example explaining the generating approach of a diffusion code, and its equipment of 3 yuan which has the zero correlation section concerning this invention.

[0012] As shown in drawing 1 thru/or drawing 3, the generator of a diffusion code 3 yuan A period receives the code of N chip (N is the natural number). The chip shift of the 3 yuan autocorrelation section PURIFADOFEA code generating section 100 which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended and a zero correlation property is maintained, and the 3 yuan zero correlation section PURIFADOFEA code by which generation was carried out [ above-mentioned ] is carried out. The 3 yuan autocorrelation section code set generator 170 which generates the code set of the zero correlation section of 3 yuan is included.

[0013] The pro fur DOFEA generating section 100 of the above-mentioned 3 yuan autocorrelation section The inside of the 3 yuan zero correlation section PURIFADOFEA code which a period is extended and has a period beyond a predetermined multiple based on the basic diffusion code formed from early basic METORIKKUSU. The code period dilator 130 which generates diffusion code of one of the two (on the other hand), and the even number term of one of the two's diffusion code by which generation was carried out [ above-mentioned ] are reversed, and the fair code generator 150 which generates the diffusion code corresponding to the code generated by the above-mentioned code period dilator 130 is included.

[0014] Moreover, the above-mentioned code period dilator 130 contains direct / parallel-conversion machine 110, the reference clock generator 111, a distributor 112, a repeater 113, the regional block inverter 114, the switch control logic section 115, the average/serializer 116, the zero aedeagus 117, and the control logic section 118.

[0015] Above-mentioned direct / parallel-conversion machine 110 are changed into juxtaposition with the clock reference signal generated by the reference clock generator 111 which mentions the serial code inputted later, and a

distributor 112 is provided with it. The above-mentioned distributor 112 distributes the juxtaposition code signal changed by direct / parallel-conversion machine 110, and provides a repeater 113 with it. The above-mentioned repeater 113 is processed in the gestalt which had the juxtaposition code signal which was distributed by the distributor 112 and inputted repeated, and the regional block inverter 114 is provided with it. The regional block inverter 114 chooses as arbitration a part of whole block (example: 1/4) of the juxtaposition code signal of the gestalt repeated from the repeater 113 by switch control of the switch control logic section 115, is reversed, and the average / serializer 116 is provided with it. Above-mentioned average / serializer 116 change into a serial signal the code signal of juxtaposition inputted from the regional block inverter 114, and provides the zero aedeagus 117 with it.

[0016] At this time, the code signal changed into the serial is inserted in zero by control of the control logic section 118, and the above-mentioned zero seedegus 117 has a period twice [further] as long as an input signal

(serial-input code inputted into direct / parallel-conversion machine 112), and outputs the code of one of the two which constitutes the PURIFADOFEA code which has the same zero correlation property.

[0017] Here, the above-mentioned zero correlation means that the side lobe and cross-correlation function of an autocorrelation peak are set to 0, and it is used for the characterization of a diffusion code in the communication link of a code division multiplex connection type.

[0018] On the other hand, although the signal outputted from the above-mentioned zero aedaeagus 117 is inputted into the fair code generator 150, by this fair code generator 150, a sign is reversed by the inverter 157 for every even number term among the code elements of the signal inputted, and the remaining term of the code element of the signal inputted generates a fair code signal, passing through a buffer 155 respectively. At this time, the fair code signal of 3 yuan generated by the fair code generator 150 is inputted into the ZCD code set generator 170, and the 3 yuan ZCD code set which has various ZCD(s) generates it.

[0019] That is, the code signal outputted from the above-mentioned fair code generator 150 is inputted into the input code circulation section 173 which consists of many delay flip flops 171. Then, the code signal inputted into delay-flip-flop 171a of the input code circulation section 173 circulates shifting 1 bit at a time to right-hand side, the output of delay-flip-flop 171b located in the right-hand side last edge returns to delay-flip-flop 171a again, and circulation is performed continuously.

[0020] The signal outputted on the other hand from T tab (TAP) signal connected with the above-mentioned input code circulation section 173 generates a code continuously by switch control by the time amount of the time amount control switch logic 175, and outputs. At this time, the code signal outputted operates with the 3 yuan ZCD code set (Ternary ZCD Code Set:

henceforth "TZCS") with which the side lobe and cross-correlation value of the peak circumference of an autocorrelation value become zero between the fixed time amount sections below a chip ( $0.75N+1$ ) mutually.

[0021] 3 yuan ZCD PURIFADOFEA (Ternary ZCD Preferred Pair : call it following "TZPP") in which the period of a code has the zero correlation property of a chip (0.75N+1) to N=4X2i (i= 0, 1, 2, 3, ...) here --- and --- The generation process of a 3 yuan ZCD code set in which it has various ZCD(s) is explained still more concretely below. First, the initial basic matrix (initial BASIC matrix) G is expressed like the following formula (1).

[0022]

[Equation 1]

(1)



(5)

[0051] Here, \*\* is the increment (chip-shift increment) of a chip shift, and k means the number to the given code which can be maximum shifted. Moreover, \*\* and k are a positive integer (positive integer) and a negative integral exponent (non-negative integer) respectively, and are surely [0052].

[Equation 11]

$$|k+1|\Delta \leq \left| \frac{2^N}{k} + 1 \right|$$

[0053] \*\*\*\*\* should be satisfied. And relation like the following formula (6) is materialized between M and ZCD of the code generated newly.

[0054]

$$M=2(k+1) \text{ and } ZCD = ** 2\delta - 1 ** \quad (6)$$

[0055] Moreover, the next table 1 shows the total numbers of codes of 3 yuan to a period 32 and 64, 128, 256 chips, such as the ZCD code.

[0056]

[Table 1]

ZCD	3	6	7	9	11	13	15	17	19	21	23	25	27	29	31	...	95	...	193
N																			
32	12	8	6	4	4	2	2	2	2	2	2	2	2	2	2	...	...	...	...
64	24	16	12	8	8	6	6	6	4	4	4	2	2	2	2	...	...	...	...
128	48	32	24	16	16	12	12	10	8	8	6	6	6	6	6	...	2	...	...
256	96	64	48	32	32	24	24	20	16	16	14	12	12	12	12	...	4	...	2

[0057] Drawing 4 is a drawing in which the autocorrelation property and cross-correlation property of a diffusion code concerning this invention are shown. As shown in drawing 4, it turns out that the section when the function value of the autocorrelation of the code of the pair which has the period of 128 chips, and the function value of a cross-correlation are set to 0, i.e., the zero correlation section, is shown, and the cross-correlation value between the circumference side lobe of the peak value of an autocorrelation function and two codes is set to 0 within the local section called 97 chips applicable to 0.75N+1 of 128 chips.

[0058] Drawing 5 is a graph [ the semi-synchronous sign and the 3 yuan ZCD code / number / classified by zero correlation section / of codes / of the diffusion applied to this invention ].

[0059] if ZCD is 3 or more \*\*\*\*\* as shown in drawing 5, the above-mentioned 3 yuan ZCD code is the more nearly same than the QS (OG-r) code and the 3 yuan ZCD code --- it turns out that reservation of very many numbers of codes is possible in ZCD. Therefore, by reservation of more numbers of codes, many users can be secured in code division multiplex connection (CDMA) communication system, and the allowed time in which semi-synchronous employment of code division multiplex connection (CDMA) communication system is possible increases by large ZCD.

[0060] Here, when applying the 3 yuan diffusion code shown by this invention to a CDMA system, more numbers, such as a diffusion code which comes to have the semi-synchronous employment time amount section larger than what kind of conventional binary diffusion code, and has the fixed zero correlation section (Zero Correlation Duration; ZCD) mutually, than other binary diffusion codes come to be generated. Therefore, to say nothing of multiplexing, when assigning the 3 yuan diffusion code concerning this invention to each channel of a CDMA system, even if it separates from the chip synchronization between codes to some extent, the orthogonality between codes (zero correlation property) can be continuously maintained between the fixed time amount sections.

[0061] Moreover, when applying the 3 yuan diffusion code which this invention was shown to a cellular (cellular) system, by the hard flow link (up-link) in a cel, employment of a CDMA system which does not need the synchronization between codes is enabled, and especially when using for a forward direction link (down-link), the effect by multi-put can be decreased by the semi-synchronous (quasi synchronous) employment section.

[0062] Moreover, in the large section of the large autocorrelation peak circumference, a side lobe can utilize the 3 yuan diffusion code shown by this invention using the property of zero in early code for synchronous prehension connected with the matched filter (matched filter).

[0063] Moreover, the part applicable to zero out of the element of the 3 yuan diffusion code by this invention When embodying in hardware, OFF (Off) actuation of a switch can be substituted. At the time of the matched filter (Matched filter) embodiment of the receive section for the back diffusion of electrons The tab multiplier which coincides with the part applicable to the zero of a code element Since it becomes zero, if the operation of the part takes an example in zero, since the parts of the adder connected with the zero tab multiplier and a multiplier become unnecessary, low-powerizing of the matched filter by reduction of the overall amount of operations is possible for them.

[0064] Moreover, the 3 yuan code by this invention is simple for the code generating approach, and is simple for the embodiment as hardware, and the continuous expandability of a code period is easy for it. That is, the die length can extend the period N of a code to twice as many magnitude as this from eight chips at infinity. The approach of this invention which was mentioned above can be embodied by the program, and can be memorized by the record media (CD-ROM, RAM and ROM, a floppy (trademark) disk, a hard disk, magneto-optic disk, etc.) which can be read by computer.

[0065] In addition, this invention is not restricted to this example. It is possible to carry out modification implementation with various gestalten within limits which do not deviate from the meaning of this invention.

[0066]

[Effect of the Invention] More diffusion codes which come to have the semi-synchronous employment time amount section larger than what kind of

conventional binary diffusion code, and have the fixed zero correlation section (Zero Correlation Duration: ZCD) mutually when this invention uses the diffusion code of 3 yuan for a CDMA system than a binary diffusion code come to be generated as mentioned above. Therefore, even if it separates from the chip synchronization between codes of 3 yuan to some extent not to mention multiplexing according a diffusion code to assignment of each channel of a CDMA system, it is effective in the orthogonality between codes (zero correlation property) being continuously maintainable between the fixed time amount sections.

[0067] Moreover, if this invention generates the 3 yuan diffusion code which has the large zero correlation section (ZCD) and is applied to a forward direction link, since an orthogonality will be continuously maintained during the fixed time amount section When it is made to have the drag force to multi-putt phenomena and is used for a hard flow link While being assigned as each diffusion code for users in the cel at the time of code division, the interference phenomenon between the user channels by the multiple access (multiple access) is made to remove, and it is effective in the ability to raise the effectiveness of a system.

[0068] Moreover, in the large section of the large autocorrelation peak circumference, it is utilisable also in code for initial synchronization prehension to which the side lobe was connected with the matched filter (matched filter) using the property of zero, and since this invention is simple for the code generating approach, it is easy to embody as hardware and effective in the continuous expandability of a code period being easy.

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**TECHNICAL FIELD**

[Field of the Invention] This invention relates to the record medium which can read by the computer which recorded the program for realizing a diffusion code generating unit and its approach, and said approach of 3 yuan which has the zero correlation section which enabled it to maintain the number of many diffusion codes, having the zero correlation property which intersects perpendicularly about a diffusion code (Ternary spreading code) generator and its approach in the time-amount section more large in a detail.

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chip, in order to solve such a trouble -- although the ZCD code is proposed, this also has the limitation that the maximum zero correlation section is a chip (0.5N+1).

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**PRIOR ART**

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[Description of the Prior Art] Generally in a code division multiplex connection (Code Division Multiple Access: CDMA) system, the channel which faces to a mobile station (Mobile Station) from a base station (Base Station) is called forward direction link (down-link), and the channel which goes to a base station from a mobile station is called hard flow link (up-Link). [0003] It sets to said CDMA system and they are each mobile station (Mobile Station) and a base. Although a station (Base Station) is a diffusion code which has a rectangular property and the Walsh code (Walsh Code) and the ADAMARU code (Hadamard Code) are used, if such a rectangular property of a rectangular code is maintained only when the synchronization between diffusion codes is only established, and a synchronization is not established, a rectangular property has the demerit in which it breaks. Therefore, since the code which intersects perpendicularly only under the conditions on which the code synchronization was established according to such demerit should be used, the interference (co-channel interference) phenomenon between the user channels which adjoin by the multiple access (multiple access) in a hard flow link was generated and the rectangular property broke by the delay wave by multi-putt, there was a trouble that a system characteristic deteriorated.

[0004] Therefore, research for finding the diffusion code in which a fixed time amount and rectangular cross property continues, and is maintained has been done briskly. moreover, recently -- a rectangular gold code -- cooperating -- although a diffusion code called constituted QS (OG-r) is proposed, since the number of the codes which can also secure this if the zero correlation section becomes large decreases extremely -- a part for a code -- there was a trouble that it could not contribute to multiplexing depended comparatively greatly.

[0005] then, the duality which the number of codes can secure from QS (OG-r) while it has the zero correlation section of the maximum (0.5N+1)

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**EFFECT OF THE INVENTION**

[Effect of the Invention] More diffusion codes which come to have the semi-synchronous employment time amount section larger than what kind of conventional binary diffusion code, and have the fixed zero correlation section (Zero Correlation Duration; ZCD) mutually when this invention uses the diffusion code of 3 yuan for a CDMA system than a binary diffusion code come to be generated as mentioned above. Therefore, even if it separates from the chip synchronization between codes of 3 yuan to some extent not to mention multiplexing according a diffusion code to assignment of each channel of a CDMA system, it is effective in the orthogonality between codes (zero correlation property) being continuously maintainable between the fixed time amount sections.

[0067] Moreover, if this invention generates the 3 yuan diffusion code which has the large zero correlation section (ZCD) and is applied to a forward direction link, since an orthogonality will be continuously maintained during the fixed time amount section When it is made to have the drag force to multi-putt phenomena and is used for a hard flow link While being assigned as each diffusion code for users in the cel at the time of code division, the interference phenomenon between the user channels by the multiple access (multiple access) is made to remove, and it is effective in the ability to raise the effectiveness of a system.

[0068] Moreover, in the large section of the large autocorrelation peak circumference, it is utilizable also in code for initial synchronization prehension to which the side lobe was connected with the matched filter (matched filter) using the property of zero, and since this invention is simple for the code generating approach, it is easy to embody as hardware and effective in the continuous expandability of a code period being easy.

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**TECHNICAL PROBLEM**

[Problem(s) to be Solved by the Invention] For this invention, it is proposed in order to solve the aforementioned conventional trouble, and a period is N chip (N). The 3 yuan diffusion code generating unit which has the zero correlation section it was made to generate the diffusion code from which the side lobe and cross-correlation value of the peak circumference of an autocorrelation value become zero between the fixed time amount sections below a chip (0.75N+1) to the code of the natural number, and its approach. The purpose is in offering the record medium which can be read by computer which recorded the program for realizing said approach.

[Translation done.]

## \* NOTICES \*

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- 2.\*\*\*\* shows the word which can not be translated.
3. In the drawings, any words are not translated.

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**MEANS**


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[Means for Solving the Problem] In order to attain the above purposes, this invention it sets to the 3 yuan diffusion code generating approach applied to the 3 yuan diffusion code (Ternary spreading code) generator which has the zero correlation section, and a period is N chip (N). The 1st step which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip ( $0.75N+1$ ) is maintained, it is characterized by having the 2nd step which generates the 3 yuan zero correlation section code set of a large number which are made to carry out the chip shift (CHIP SHIFT) of said generated 3 yuan zero correlation section PURIFADOFEA code, and have a zero correlation property below a chip ( $0.75N+1$ ).

[0008] Moreover, for this invention, it sets to the 3 yuan diffusion code generating unit which has the zero correlation section, and a period is N chip (N). The 3 yuan autocorrelation section PURIFADOFEA code generating means for generating the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip ( $0.75N+1$ ) is maintained. The chip shift of the 3 yuan zero correlation section PURIFADOFEA code generated by the autocorrelation section PURIFADOFEA code generating means is carried out. [of said 3 yuan] ( $0.75N+1$ ) It is characterized by having a 3 yuan autocorrelation section code set generating means for generating the 3 yuan zero correlation section code set of a large number which have a zero correlation property below a chip.

[0009] Moreover, for this invention, a period is N chip (N) to the 3 yuan diffusion code generating unit equipped with the processor which has the zero correlation section. The 1st function which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended to the code of the natural number, and the zero correlation property of a chip ( $0.75N+1$ ) is maintained. The chip shift of said generated 3 yuan zero correlation section PURIFADOFEA code is carried out. ( $0.75N+1$ ) The record medium which can be

read by computer which recorded the program for realizing the 2nd function which generates the 3 yuan zero correlation section code set of a large number which have a zero correlation property below a chip is offered.

[0010]

[Embodiment of the Invention] One desirable example concerning this invention is explained to a detail, referring to the attached drawing hereafter.

[0011] Drawing 1 thru/ or drawing 3 are the block block diagrams of one example explaining the generating approach of a diffusion code, and its equipment of 3 yuan which has the zero correlation section concerning this invention.

[0012] As shown in drawing 1 thru/ or drawing 3, the generator of a diffusion code 3 yuan A period receives the code of N chip (N is the natural number). The chip shift of the 3 yuan autocorrelation section PURIFADOFEA code generating section 100 which generates the 3 yuan zero correlation section PURIFADOFEA code in which a code period is extended and a zero correlation property is maintained, and the 3 yuan zero correlation section PURIFADOFEA code by which generation was carried out [above-mentioned] is carried out. The 3 yuan autocorrelation section code set generator 170 which generates the code set of the zero correlation section of 3 yuan is included.

[0013] The pro fur DOFEA generating section 100 of the above-mentioned 3 yuan autocorrelation section The inside of the 3 yuan zero correlation section PURIFADOFEA code which a period is extended and has a period beyond a predetermined multiple based on the basic diffusion code formed from early basic METORIKKUSU. The code period dilator 130 which generates diffusion code of one of the two (on the other hand), and the even number term of one of the two's diffusion code by which generation was carried out [above-mentioned] are reversed, and the fair code generator 150 which generates the diffusion code corresponding to the code generated by the above-mentioned code period dilator 130 is included.

[0014] Moreover, the above-mentioned code period dilator 130 contains direct / parallel-conversion machine 110, the reference clock generator 111, a distributor 112, a repeater 113, the regional block inverter 114, the switch control logic section 115, the average/serializer 116, the zero aedeagus 117, and the control logic section 118.

[0015] Above-mentioned direct / parallel-conversion machine 110 are changed into juxtaposition with the clock reference signal generated by the reference clock generator 111 which mentions the serial code inputted later, and a distributor 112 is provided with it. The above-mentioned distributor 112 distributes the juxtaposition code signal changed by direct / parallel-conversion machine 110, and provides a repeater 113 with it. The above-mentioned repeater 113 is processed in the gestalt which had the juxtaposition code signal which was distributed by the distributor 112 and inputted repeated, and the regional block inverter 114 is provided with it. The regional block inverter 114 chooses as arbitration a part of whole block (example: 1/4) of the juxtaposition

code signal of the gestalt repeated from the repeater 113 by switch control of the switch control logic section 115, is reversed, and the average / serializer 116 is provided with it. Above-mentioned average / serializer 116 change into a serial signal the code signal of juxtaposition inputted from the regional block inverter 114, and provides the zero aedeagus 117 with it.

[0016] At this time, the code signal changed into the serial is inserted in zero by control of the control logic section 118, and the above-mentioned zero aedeagus 117 has a period twice [further] as long as an input signal (serial-input code inputted into direct / parallel-conversion machine 112), and outputs the code of one of the two which constitutes the PURIFADOFEA code which has the same zero correlation property.

[0017] Here, the above-mentioned zero correlation means that the side lobe and cross-correlation function of an autocorrelation peak are set to 0, and it is used for the characterization of a diffusion code in the communication link of a code division multiplex connection type.

[0018] On the other hand, although the signal outputted from the above-mentioned zero aedeagus 117 is inputted into the fair code generator 150, by this fair code generator 150, a sign is reversed by the inverter 157 for every even number term among the code elements of the signal inputted, and the remaining term of the code element of the signal inputted generates a fair code signal, passing through a buffer 155 respectively. At this time, the fair code signal of 3 yuan generated by the fair code generator 150 is inputted into the ZCD code set generator 170, and the 3 yuan ZCD code set which has various ZCD(s) generates it.

[0019] That is, the code signal outputted from the above-mentioned fair code generator 150 is inputted into the input code circulation section 173 which consists of many delay flip flops 171. Then, the code signal inputted into delay-flip-flop 171a of the input code circulation section 173 circulates shifting 1 bit at a time to right-hand side, the output of delay-flip-flop 171b located in the right-hand side last edge returns to delay-flip-flop 171a again, and circulation is performed continuously.

[0020] The signal outputted on the other hand from T tab (TAP) signal connected with the above-mentioned input code circulation section 173 generates a code continuously by switch control by the time amount of the time amount control switch logic 175, and outputs. At this time, the code signal outputted operates with the 3 yuan ZCD code set (Ternary ZCD Code Set: henceforth "TZCS") with which the side lobe and cross-correlation value of the peak circumference of an autocorrelation value become zero between the fixed time amount sections below a chip (0.75N+1) mutually.

[0021] 3 yuan ZCD PURIFADOFEA (Ternary ZCD Preferred Pair: call it following "TZPP") in which the period of a code has the zero correlation property of a chip (0.75N+1) to N=4x2l (l=0, 1, 2, 3, ...) here --- and --- The generation process of a 3 yuan ZCD code set in which it has various ZCD(s) is

explained still more concretely below. First, the initial basic matrix (initial BASIC matrix) G is expressed like the following formula (1).

[0022]

[Equation 1]

$$GA = \begin{bmatrix} + & z & + & z & + & z & - & z \\ + & z & + & z & - & z & + & z \\ + & z & - & z & + & z & + & z \\ - & z & + & z & + & z & + & z \end{bmatrix} \quad \text{OR} \quad GB = \begin{bmatrix} + & + & z & z & + & - & z & z \\ + & + & z & z & - & + & z & z \\ + & - & z & z & + & + & z & z \\ - & + & z & z & + & + & z & z \end{bmatrix} \quad (1)$$

[0023] Here, within Matrix GA or Matrix GB, 1 and -1 were expressed in (-) as (+) for convenience, respectively. Moreover, z means the zero which carried out padding (padding).

[0024] the line of the arbitration which constitutes the above-mentioned matrices GA or GB --- diffusion code C(a)8=C(a)0, ..., C(a)7 = (e0, z, e1, z, e2, z, e3, z) of periodic 8 chip --- or (e0, e1, z, z, e2, e3, z, z) --- \*\* --- if it says --- diffusion code C(b)8=C(b)0, ..., C(b)7 = (v0, z, v1, z, v2, z, v3, z) of others [C / (a) / 8] --- or (v0, v1, z, z, v2, v3, z, z) --- generating --- obtaining --- although --- this --- the time --- C --- (-a) --- eight --- C --- (-b) --- eight --- relation --- Vq=(-1) qeq (q=0, 1, 2, 3) --- like --- becoming, here --- these --- a period --- eight --- a pair --- a code --- (-C) --- (-a) --- eight --- C --- (-b) --- eight --- the zero correlation section of a chip (0.75x8+1) --- having --- these --- the first stage TZPP (initial Ternary ZCD Preferred Pair) --- giving a definition.

[0025] Here, the above-mentioned zero correlation section (ZCD) is the continuous section when the side lobe and cross-correlation function of an autocorrelation peak are set to 0, and means the section when the side lobe and cross-correlation value of peak value of an autocorrelation function become 0 continuously in the local section centering on the peak value of an autocorrelation function.

[0026] Subsequently, the extended matrix which makes the period of TZPP extend twice is explained below, the first stage --- TZPP --- constituting (C(a)8 and C(b)8) --- setting --- one --- a piece --- a code --- an escape --- a matrix --- inputting --- a case --- the --- outputting --- having had --- a matrix --- arbitration --- a line --- gaining --- outputting --- if --- this --- a period --- two --- twice --- it is --- 16 --- chips --- extending --- having had --- a code --- C --- (-a) --- 16 --- becoming. Subsequently, it is the sign of the even number term which constitutes a code using this C(a)16 [0027]

[Equation 2]

$$s_q^{(p)} = (-1)^q z_q^{(p)} (q=0, 1, \dots, 15)$$

[0028] \*\* --- if the actuation reversed like is added, C(b)16 will be generated. Here, the actuation which extends the period of TBZPP can be generalized and it can express to the following formula (2). That is, when TZPP (C(a) m and C

[Equation 11]

$$|(k+1)\Delta| \leq \left| \frac{2\pi}{\delta} + 1 \right|$$

[0053] \*\*\*\*\* should be satisfied. And relation like the following formula (6) is materialized between M and ZCD of the code generated newly.

[0054]

$$M=2(k+1) \text{ and } ZCD = ** 2\delta-1 ** \quad (6)$$

[0055] Moreover, the next table 1 shows the total numbers of codes of 3 yuan to a period 32 and 64, 128, 256 chips, such as the ZCD code.

[0056]

[Table 1]

Xo	5	6	7	9	11	13	15	17	19	21	23	25	27	29	31	...	95	...	193
D																			
N																			
32	12	8	6	4	4	2	2	2	2	2	2	2	2	2	2	...	...	...	...
64	24	16	12	8	6	6	6	6	4	4	4	4	2	2	2	...	...	...	...
128	48	32	24	16	16	12	12	10	8	8	6	6	6	6	6	...	2	...	...
256	96	64	48	32	32	26	24	20	18	16	16	14	12	12	12	...	4	...	2

[0057] Drawing 4 is a drawing in which the autocorrelation property and cross-correlation property of a diffusion code concerning this invention are shown. As shown in drawing 4, it turns out that the section when the function value of the autocorrelation of the code of the pair which has the period of 128 chips, and the function value of a cross-correlation are set to 0, i.e., the zero correlation section, is shown, and the cross-correlation value between the circumference side lobe of the peak value of an autocorrelation function and two codes is set to 0 within the local section called 97 chips applicable to 0.75N+1 of 128 chips.

[0058] Drawing 5 is a graph [ the semi-synchronous sign and the 3 yuan ZCD code / number / classified by zero correlation section / of codes / of the diffusion applied to this invention ].

[0059] if ZCD is 3 or more \*\*\*\*\* as shown in drawing 5, the above-mentioned 3 yuan ZCD code is the more nearly same than the QS (OG-r) code and the 3 yuan ZCD code --- it turns out that reservation of very many numbers of codes is possible in ZCD. Therefore, by reservation of more numbers of codes, many users can be secured in code division multiplex connection (CDMA) communication system, and the allowed time in which semi-synchronous employment of code division multiplex connection (CDMA) communication system is possible increases by large ZCD.

[0060] Here, when applying the 3 yuan diffusion code shown by this invention to a CDMA system, more numbers, such as a diffusion code which comes to have the semi-synchronous employment time amount section larger than what kind of conventional binary diffusion code, and has the fixed zero correlation section (Zero Correlation Duration; ZCD) mutually, than other binary diffusion codes come to be generated. Therefore, to say nothing of multiplexing, when assigning the 3 yuan diffusion code concerning this invention to each channel of a CDMA

system, even if it separates from the chip synchronization between codes to some extent, the orthogonality between codes (zero correlation property) can be continuously maintained between the fixed time amount sections.

[0061] Moreover, when applying the 3 yuan diffusion code which this invention was shown to a cellular (cellular) system, by the hard flow link (up-link) in a cel, employment of a CDMA system which does not need the synchronization between codes is enabled, and especially when using for a forward direction link (down-link), the effect by multi-putt can be decreased by the semi-synchronous (quasi synchronous) employment section.

[0062] Moreover, in the large section of the large autocorrelation peak circumference, a side lobe can utilize the 3 yuan diffusion code shown by this invention using the property of zero in early code for synchronous prehension connected with the matched filter (matchedfilter).

[0063] Moreover, the part applicable to zero out of the element of the 3 yuan diffusion code by this invention When embodying in hardware, OFF (Off) actuation of a switch can be substituted. At the time of the matched filter (Matched filter) embodiment of the receive section for the back diffusion of electrons The tab multiplier which coincides with the part applicable to the zero of a code element Since it becomes zero, if the operation of the part takes an example in zero, since the parts of the adder connected with the zero tab multiplier and a multiplier become unnecessary, low-power-izing of the matched filter by reduction of the overall amount of operations is possible for them.

[0064] Moreover, the 3 yuan code by this invention is simple for the code generating approach, and is simple for the embodiment as hardware, and the continuous expandability of a code period is easy for it. That is, the die length can extend the period N of a code to twice as many magnitude as this from eight chips at infinity. The approach of this invention which was mentioned above can be embodied by the program, and can be memorized by the record media (CD-ROM, RAM and ROM, a floppy (trademark) disk, a hard disk, magneto-optic disk, etc.) which can be read by computer.

[0065] In addition, this invention is not restricted to this example. It is possible to carry out modification implementation with various gestalten within limits which do not deviate from the meaning of this invention.

[Translation done.]

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] It is the block block diagram of one example explaining the 3 yuan diffusion code generating process in which it has the zero correlation section concerning this invention.

[Drawing 2] It is the block block diagram of one example of the 3 yuan ZCD (Zero Correlation Duration) PURIFADOFEA generating section shown in drawing 1.

[Drawing 3] It is the detail block block diagram of one example of the 3 yuan ZCD code set generator shown in drawing 1.

[Drawing 4] It is drawing showing the autocorrelation property and cross-correlation property of a diffusion code concerning this invention.

[Drawing 5] It is a graph [ the semi- synchronous sign and the 3 yuan ZCD code / number / of codes / according to zero correlation section of the diffusion code applied to this invention ].

[Description of Notations]

100 3 Yuan ZCD PURIFADOFEA Code Generating Section

130 Code Period Dilator

150 Fair Code Generator

170 3 Yuan ZCD Code Set Generator

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[Translation done.]

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(71)出願人 596180076

韓国電子通信研究院

Electronics and Telecommunications Research Institute

大韓民国大田廣域市儒城區柯亭洞161

(72)発明者 チャ ジェサン

大韓民国 デジョンシ ユソング ジョン  
ミンドン エクスポ アパートメント  
101-604

(74)代理人 100077481

弁理士 谷 義一 (外2名)

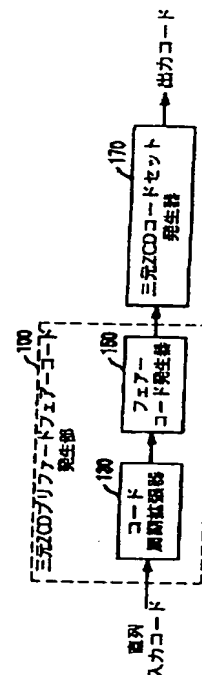
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(54)【発明の名称】 ゼロ相関区間を有する三元拡散コード発生装置及びその方法

(57)【要約】

【課題】 本発明は、ゼロ相関区間を有する三元拡散コード発生装置及びその方法と上記方法を実現させるためのプログラムを記録したコンピュータで読み取ることのできる記録媒体に関する。

【解決手段】 ゼロ相関区間を有する三元拡散コード発生装置に適用される三元拡散コード発生方法において、周期がNチップ(Nは、自然数)のコードに対してコード周期を拡張して(0.75N+1)チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアーコードを生成する第1ステップと、前記生成された三元ゼロ相関区間プリファードフェアーコードをチップシフト(CHIP SHIFT)させて(0.75N+1)チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成する第2ステップとを含む。





## 【特許請求の範囲】

【請求項 1】 ゼロ相関区間を有する三元拡散コード (Ternary spreading code) 発生装置に適用される三元拡散コード発生方法において、  
周期が  $N$  チップ ( $N$  は、自然数) のコードに対してコード周期を拡張して  $(0.75N+1)$  チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアーコードを生成する第 1 ステップと、  
前記生成された三元ゼロ相関区間プリファードフェアーコードをチップシフト (CHIP SHIFT) させて  $(0.75N+1)$  チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成する第 2 ステップとを備えることを特徴とするゼロ相関区間を有する三元拡散コード発生方法。

【請求項 2】 前記第 1 ステップは、  
初期の基礎メトリックスから基礎拡散コードを形成する第 3 ステップと、  
前記形成された基礎拡散コードに基づいて、周期が拡張されて、所定の倍数以上の周期により  $(0.75N+1)$  チップのゼロ相関特性を有する三元ゼロ相関区間プリファードフェアーコードの内、片方の三元拡散コードを生成する第 4 ステップと、  
前記生成された片方のコードの偶数項を反転させて、前記第 4 ステップで生成された拡散コードに対応する三元拡散コードを生成する第 5 ステップとを含むことを特徴とする請求項 1 に記載のゼロ相関区間を有する三元拡散コード発生方法。

【請求項 3】 前記生成された三元拡散コードは、  
整合フィルターと結びついた初期の同期捕捉用コードとして用いられることを特徴とする請求項 1 または請求項 2 に記載のゼロ相関区間を有する三元拡散コード発生方法。

【請求項 4】 前記生成された三元拡散コードは、  
コード分割多重接続 (Code Division Multiple Access: CDMA) システムにおいて、各チャンネルの多重化及びコード間のチップ同期に用いられることを特徴とする請求項 1 または請求項 2 に記載のゼロ相関区間を有する三元拡散コード発生方法。

【請求項 5】 前記生成された三元拡散コードは、  
セルラー (Cellular) システムの逆方向リンクに用いられ、コード間の同期が要らないシステムの運用を可能にし、順方向リンクに用いられて、準同期運用区間によるマルチパスを減少させることを特徴とする請求項 1 または請求項 2 に記載のゼロ相関区間を有する三元拡散コード発生方法。

【請求項 6】 前記生成された三元拡散コードは、  
拡張マトリックスを生成して、各行、またはその各行の符号の一部を反転させた行を介して、コードを拡張することを特徴とする請求項 1 または請求項 2 に記載のゼロ相関区間を有する三元拡散コード発生方法。

【請求項 7】 前記生成された三元拡散コードは、  
逆拡散のための整合フィルターをハードウェア的に具現する時に、タブ係数の半分となるゼロタブ係数と連結される加算及び乗算部の回路を除去した低消費電力型の整合フィルターに用いられることを特徴とする請求項 1 または請求項 2 に記載のゼロ相関区間を有する三元拡散コード発生方法。

【請求項 8】 ゼロ相関区間を有する三元拡散コード発生装置において、

周期が  $N$  チップ ( $N$  は、自然数) のコードに対してコード周期を拡張して  $(0.75N+1)$  チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアーコードを生成するための三元自己相関区間プリファードフェアーコード発生手段と、

前記三元自己相関区間プリファードフェアーコード発生手段により生成された三元ゼロ相関区間プリファードフェアーコードをチップシフトさせて、 $(0.75N+1)$  チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成するための三元自己相関区間コードセット発生手段とを備えることを特徴とするゼロ相関区間を有する三元拡散コード発生装置。

【請求項 9】 前記三元自己相関区間プリファードフェアーコード発生手段は、

初期の基礎メトリックスから形成した基礎拡散コードに基づいて、周期が拡張されて所定の倍数以上の周期を有する三元ゼロ相関区間プリファードフェアーコードの内、片方の三元拡散コードを生成するコード周期拡張手段と、

前記コード周期の拡張手段により生成された片方の拡散コードの偶数項を反転させて前記コード周期拡張手段により生成されたコードに対応する三元拡散コードを生成するフェアーコード発生手段とを含むことを特徴とする請求項 8 に記載のゼロ相関区間を有する三元拡散コード発生装置。

【請求項 10】 前記生成された三元拡散コードは、  
整合フィルターと結びついた初期の同期捕捉用コードとして用いられることを特徴とする請求項 8 または請求項 9 に記載のゼロ相関区間を有する三元拡散コード発生装置。

【請求項 11】 前記生成された三元拡散コードは、  
コード分割多重接続 (Code Division Multiple Access: CDMA) システムにおいて、各チャンネルの多重化及びコード間のチップ同期に用いられることを特徴とする請求項 8 または請求項 9 に記載のゼロ相関区間を有する三元拡散コード発生装置。

【請求項 12】 前記生成された三元拡散コードは、  
セルラーシステムの逆方向リンクに用いられて、コード間の同期が要らないシステムの運用を可能にし、順方向リンクに用いられて、準同期運用区間によるマルチパスを減少させることを特徴とする請求項 8 または請求項 9

に記載のゼロ相関区間を有する三元拡散コード発生装置。

【請求項13】 前記生成された三元拡散コードは、拡張マトリックスを生成して、各行、またはその各行の符号の一部を反転させた行を介してコードを拡張することを特徴とする請求項8または請求項9に記載のゼロ相関区間を有する三元拡散コード発生装置。

【請求項14】 前記生成された三元拡散コードは、逆拡散のための整合フィルターをハードウェア的に具現する時に、タブ係数の半分となるゼロタブ係数と連結される、加算及び乗算部の回路を除去した低消費電力型の整合フィルターに用いられることを特徴とする請求項8または請求項9に記載のゼロ相関区間を有する三元拡散コード発生装置。

【請求項15】 プロセッサを備えた、ゼロ相関区間を有する三元拡散コード発生装置に、周期が $N$ チップ( $N$ は、自然数)のコードに対してコード周期を拡張して、 $(0.75N+1)$ チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアーコードを生成する第1機能と、前記生成された三元ゼロ相関区間プリファードフェアーコードをチップシフトさせて、 $(0.75N+1)$ チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成する第2機能とを実現させるためのプログラムを記録したコンピュータで読み取ることのできる記録媒体。

【発明の詳細な説明】

【0001】

【発明の属する技術分野】 本発明は、ゼロ相関区間を有する三元拡散コード (Ternary spreading code) 発生装置及びその方法に関し、より詳細には、広い時間区間で直交するゼロ相関特性を有しながら、多くの拡散コードの数を維持し得るようにしたゼロ相関区間を有する三元拡散コード発生装置及びその方法と、前記方法を実現させるためのプログラムを記録したコンピュータで読み取ることのできる記録媒体に関する。

【0002】

【従来の技術】 一般的に、コード分割多重接続 (Code Division Multiple Access: CDMA) システムにおいて、基地局 (Base Station) から移動局 (Mobile Station) に向かうチャンネルを順方向リンク (down-link) と言い、移動局から基地局に向かうチャンネルを逆方向リンク (up-link) という。

【0003】 前記CDMAシステムにおいて、各移動局 (Mobile Station) や基地局 (Base Station) は、直交特性を有する拡散コードであって、ウォルシュコード (Walsh Code) やアダマールコード (Hadamard Code) を用いているが、このような直交コードの直交特性は、単に拡散コード間の同期が確立された場合のみ維持され、少しでも同期が確立されなければ、直交特性は壊れるという短所

がある。従って、このような短所によりコード同期が確立された条件下でのみ直交するコードを用いるべきであり、逆方向リンクでのマルチプルアクセス (multiple access) により隣接するユーザーチャンネル間の干渉 (co-channel interference) 現象が発生され、マルチパットによる遅延波により直交特性が壊れるので、システム特性が劣化するという問題点があった。

【0004】 従って、一定時間、直交特性が継続して維持される拡散コードを見つけるための研究が盛んに行われてきた。また、最近では直交ゴールドコードの組み合わせにより構成されたQS (OG-r) という拡散コードが提案されているが、これもゼロ相関区間が広くなれば、確保し得るコードの数が極めて少なくなるのでコード分割による多重化に大きく寄与できないという問題点があった。

【0005】 そこで、このような問題点を解決するため、最大  $(0.5N+1)$  チップのゼロ相関区間を有しながら、コード数がQS (OG-r) より多く確保できる二元ZCDコードが提案されているが、これも最大ゼロ相関区間が  $(0.5N+1)$  チップであるという限界がある。

【0006】

【発明が解決しようとする課題】 本発明は、前記の従来の問題点を解決するために提案されたものであって、周期が $N$ チップ( $N$ は、自然数)のコードに対して自己相関値のピーク周辺のサイドローブと相互相関値が  $(0.75N+1)$  チップ以下の一定時間区間の間にゼロになる拡散コードを発生し得るようにしたゼロ相関区間を有する三元拡散コード発生装置及びその方法と、前記方法を実現させるためのプログラムを記録したコンピュータで読み取ることのできる記録媒体を提供するにその目的がある。

【0007】

【課題を解決するための手段】 前記のような目的を達成するため、本発明は、ゼロ相関区間を有する三元拡散コード (Ternary spreading code) 発生装置に適用される三元拡散コード発生方法において、周期が $N$ チップ( $N$ は、自然数)のコードに対してコード周期を拡張して  $(0.75N+1)$  チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアーコードを生成する第1ステップと、前記生成された三元ゼロ相関区間プリファードフェアーコードをチップシフト (CHIP SHIFT) させて  $(0.75N+1)$  チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成する第2ステップとを備えることを特徴とする。

【0008】 また、本発明は、ゼロ相関区間を有する三元拡散コード発生装置において、周期が $N$ チップ( $N$ は、自然数)のコードに対してコード周期を拡張して  $(0.75N+1)$  チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアーコードを生成するための三元自己相関区間プリファードフェアーコード発生手段と、前記三元自己相関区間プリファードフェアーコード発生手段により生成された三元ゼロ相関区間プリファードフェア

ーコードをチップシフトさせて、 $(0.75N+1)$ チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成するための三元自己相関区間コードセット発生手段とを備えることを特徴とする。

【0009】また、本発明は、プロセッサを備えた、ゼロ相関区間を有する三元拡散コード発生装置に、周期が $N$ チップ( $N$ は、自然数)のコードに対してコード周期を拡張して、 $(0.75N+1)$ チップのゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアコードを生成する第1機能と、前記生成された三元ゼロ相関区間プリファードフェアコードをチップシフトさせて、 $(0.75N+1)$ チップ以下のゼロ相関特性を有する多数の三元ゼロ相関区間コードセットを生成する第2機能とを実現させるためのプログラムを記録したコンピュータで読み取ることのできる記録媒体を提供する。

【0010】

【発明の実施の形態】以下、添付した図面を参照しながら、本発明にかかる好ましい一実施例を詳細に説明する。

【0011】図1ないし図3は、本発明にかかるゼロ相関区間を有する三元拡散コードの発生方法及びその装置を説明する一実施例のブロック構成図である。

【0012】図1ないし図3に示したように、三元拡散コードの発生装置は、周期が $N$ チップ( $N$ は、自然数)のコードに対して、コード周期を拡張してゼロ相関特性が維持される三元ゼロ相関区間プリファードフェアコードを生成する三元自己相関区間プリファードフェアコード発生部100及び上記生成された三元ゼロ相関区間プリファードフェアコードをチップシフトさせて、三元ゼロ相関区間のコードセットを生成する三元自己相関区間コードセット発生器170を含む。

【0013】上記三元自己相関区間のプリファードフェア発生部100は、初期の基礎メトリックスから形成した基礎拡散コードに基づいて、周期が拡張されて所定の倍数以上の周期を有する三元ゼロ相関区間プリファードフェアコードの内、片方(一方)の拡散コードを生成するコード周期拡張器130及び上記生成された片方の拡散コードの偶数項を反転させて、上記コード周期拡張器130により生成されたコードに対応する拡散コードを生成するフェアコード発生器150を含む。

【0014】また、上記コード周期拡張器130は、直/並列変換器110、基準クロック発生器111、分配器112、リピーター113、部分ブロックインバータ114、スイッチ制御ロジック部115、並/直列変換器116、ゼロ挿入器117及び制御ロジック部118を含む。

【0015】上記直/並列変換器110は、入力される直列コードを後述する基準クロック発生器111で発生したクロック基準信号により並列に変換して分配器112に提供する。上記分配器112は、直/並列変換器110により変換された並列コード信号を分配して、リピーター113に提

供する。上記リピーター113は、分配器112により分配されて入力された、並列コード信号を反復された形態に処理して、部分ブロックインバータ114に提供する。部分ブロックインバータ114は、リピーター113から反復された形態の並列コード信号をスイッチ制御ロジック部115のスイッチ制御により、全体ブロックの一部(例:1/4)のみを任意に選択し反転して、並/直列変換器116に提供する。上記並/直列変換器116は、部分ブロックインバータ114から入力される並列のコード信号を直列信号に変換してゼロ挿入器117に提供する。

【0016】この時、上記ゼロ挿入器117は、直列に変換されたコード信号を制御ロジック部118の制御によりゼロが挿入されて、周期が入力信号(直/並列変換器112に入力される直列入力コード)よりさらに2倍長く、同じゼロ相関特性を有するプリファードフェアコードを構成する片方のコードを出力する。

【0017】ここで、上記ゼロ相関は、自己相関ピークのサイドローブと相互相関関数が0になることを意味し、コード分割多重接続方式の通信において拡散コードの特性評価に用いられる。

【0018】一方、上記ゼロ挿入器117から出力された信号は、フェアコード発生器150に入力されるが、このフェアコード発生器150では、入力される信号のコード構成要素のうち、偶数項毎にインバータ157により符号が反転され、入力される信号のコード構成要素の残り項は、バッファ155を各々経ながらフェアコード信号を生成する。この時、フェアコード発生器150により生成されたフェアコード信号は、三元ZCDコードセット発生器170に入力されて、多様なZCDを有する三元ZCDコードセットが発生する。

【0019】すなわち、上記フェアコード発生器150より出力されるコード信号は、多数の遅延フリップフロップ171からなる入力コード循環部173に入力される。すると、入力コード循環部173の遅延フリップフロップ171aに入力されたコード信号は、1ビットずつ右側にシフトしながら循環し、右側の最終端に位置した遅延フリップフロップ171bの出力が再度遅延フリップフロップ171aに帰還して、循環が連続的に実行される。

【0020】一方、上記入力コード循環部173に連結されたTタブ(TAP)信号から出力される信号は、時間制御スイッチロジック175の時間によるスイッチ制御によりコードを連続的に生成して出力する。この時、出力されるコード信号は、互いに自己相関値のピーク周辺のサイドローブと相互相関値が $(0.75N+1)$ チップ以下の一定時間区間の間にゼロになる三元ZCDコードセット(Ternary ZCD Code Set: 以下"TZCS"という)で動作する。

【0021】ここで、コードの周期が $N=4 \times 2^i$  ( $i=0,1,2,3,\dots$ )に対して、 $(0.75N+1)$ チップというゼロ相関特性を有する三元ZCDプリファードフェア(Ternary ZCD Preferred Pair: 以下"TZPP"という)及び多様なZCDを有

する三元ZCDコードセットの生成過程を以下でさらに具体的に説明する。まず、初期基礎マトリックス(initial basic matrix)Gを次の式 (1) のように表す。

$$GA = \begin{bmatrix} + & z & + & z & + & z & - & z \\ + & z & + & z & - & z & + & z \\ + & z & - & z & + & z & + & z \\ - & z & + & z & + & z & + & z \end{bmatrix} \quad \text{OR} \quad GB = \begin{bmatrix} + & + & z & z & + & - & z & z \\ + & + & z & z & - & + & z & z \\ + & - & z & z & + & + & z & z \\ - & + & z & z & + & + & z & z \end{bmatrix} \quad (1)$$

【0023】ここで、マトリックスGA、またはマトリックスGB内では、便宜上1と-1をそれぞれ(+)と(-)で表した。また、zはパディング(padding)したゼロを意味する。

【0024】上記マトリックスGA、またはGBを構成する任意の行を周期8チップの拡散コード $C^{(a)}_8 = (C^{(a)}_0, \dots, C^{(a)}_7) = (e_0, z, e_1, z, e_2, z, e_3, z)$ 、または $(e_0, e_1, z, z, e_2, e_3, z, z)$ といえ、 $C^{(a)}_8$ から他の拡散コード $C^{(b)}_8 = (C^{(b)}_0, \dots, C^{(b)}_7) = (v_0, z, v_1, z, v_2, z, v_3, z)$ 、または $(v_0, v_1, z, z, v_2, v_3, z, z)$ を生成し得るが、この時の $C^{(a)}_8$ と $C^{(b)}_8$ の関係は、 $V_q = (-1)^q e_q$  ( $q=0,1,2,3$ )のようになる。ここで、これらの周期8の一对のコード $(C^{(a)}_8, C^{(b)}_8)$ は、 $(0.75 \times 8 + 1)$ チップのゼロ相関区間を有し、これらを初期TZPP(initial Ternary ZCD Preferred Pair)と定義する。

【0025】ここで、上記ゼロ相関区間(ZCD)は、自己相関ピークのサイドローブと相互相関関数とが0になる連続的な区間であって、自己相関関数のピーク値を中心にした局所的な区間で連続的に自己相関関数のピーク値のサイドローブと相互相関値が0になる区間を意味する。

$$DA = \begin{bmatrix} X & Z & Y & Z & X & Z & -Y & Z \\ X & Z & Y & Z & -X & Z & Y & Z \\ X & Z & -Y & Z & X & Z & Y & Z \\ X & Z & Y & Z & X & Z & Y & Z \end{bmatrix} \quad \text{OR} \quad DB = \begin{bmatrix} V & W & Z & Z & V & -W & Z & Z \\ V & W & Z & Z & -V & W & Z & Z \\ V & -W & Z & Z & V & W & Z & Z \\ -V & W & Z & Z & V & W & Z & Z \end{bmatrix} \quad (2)$$

【0030】ここで、コードの周期は $m=4 \times 2^i$  ( $i=1,2,3,\dots$ )を意味する。そして、

$$X = (c_0^{(a)}, \dots, c_{\frac{m}{4}-1}^{(a)}, c_{\frac{m}{2}}^{(a)}, \dots, c_{\frac{3m}{4}-1}^{(a)}), \quad Y = (c_{\frac{m}{4}}^{(a)}, \dots, c_{\frac{m}{2}-1}^{(a)}, c_{\frac{m}{2}}^{(a)}, \dots, c_{\frac{3m}{4}-1}^{(a)}), \quad w = (c_{\frac{m}{4}}^{(a)}, \dots, c_{\frac{3m}{4}-1}^{(a)})$$

【0032】また $Z=m/4$ 個のゼロを意味する。また、DAは、 $\pm GA$ から派生した行列のみに適用される。

【0033】上記DBは、 $\pm GB$ から派生した行列のみに適用される。

【0034】上記 $\pm DA$ 、または $\pm DB$ の任意の行は、 $2m$ の周期を有した $C^{(a)}_{2m} = (C^{(a)}_0, C^{(a)}_1, C^{(a)}_2, \dots, C^{(a)}_{2m-1})$ になり、 $C^{(a)}_{2m}$ を用いれば、 $C^{(b)}_{2m} = (C^{(b)}_0, C^{(b)}_1, C^{(b)}_2, \dots, C^{(b)}_{2m-1})$ が生成される。そして、

【0035】

【0022】  
【数1】

【0026】次いで、TZPPの周期を2倍に拡張させる拡張マトリックスについて以下に説明する。初期TZPPを構成する $(C^{(a)}_8, C^{(b)}_8)$ において、1個のコードを拡張マトリックスに入力する場合、その出力されたマトリックスの任意の行を獲得して出力すれば、これは周期が2倍である16チップに拡張されたコード $C^{(a)}_{16}$ となる。次いで、この $C^{(a)}_{16}$ を用いて、コードを構成する偶数項の符号を

【0027】

【数2】

$$S_q^{(b)} = (-1)^q s_q^{(a)} \quad (q=0,1,\dots,15)$$

【0028】のように反転させる動作を加えれば、 $C^{(b)}_{16}$ が生成される。ここで、TBZPPの周期を拡張する動作を一般化して、下記の式(2)に表すことができる。即ち、周期 $m$ を有する任意のTZPP $(C^{(a)}_m, C^{(b)}_m)$ が与えられた時、2倍周期 $2m$ を一つの行の長さとして有するようになる拡張マトリックスDA、またはDBは、次の式(2)のように構成される。

【0029】

【数3】

【0031】

【数4】

【数5】

$$c_q^{(b)} = (-1)^q c_q^{(a)} \quad (q=0,1,\dots,2m-1)$$

【0036】の関係が成立する。この時、

【0037】

【数6】

$$\{c_{2m}^{(a)}, c_{2m}^{(b)}\}$$

50 【0038】は $(0.75 \times 2m + 1)$ チップのゼロ相関区間を有

するTZPPとなる。従って、 $N=4 \times 2^i$  ( $i=0,1,2,3,\dots$ )の周期に対して $(0.75N+1)$ チップのゼロ相関区間を有するTZPP

【0039】

【数7】

$$\{C_N^{(a)}, C_N^{(b)}\}$$

$$\left\{ \begin{array}{l} C_{16}^{(a)} = (+ + z z + - z z + z z + z z) \\ C_{16}^{(b)} = (+ - z z + z z + z z - z z) \end{array} \right\} \text{または} \left\{ \begin{array}{l} C_{16}^{(a)} = (+ + + - z z z z + - + z z z z) \\ C_{16}^{(b)} = (+ - + + z z z z + - - z z z z) \end{array} \right\} \quad (3)$$

【0043】そして、次の式(4)は、128チップの周期と97チップのゼロ相関区間を有するコードフェアー{C

【0044】

【数9】

(a)  $C_{128}^{(a)}$ ,  $C_{128}^{(b)}$ の例を示すものである。

$$\left\{ \begin{array}{l} C_{128}^{(a)} = (A \ B \ A \ -B \ Z_{16} \ A \ B \ -A \ B \ Z_{16} \ A \ B \ A \ -B \ Z_{16} \ -A \ -B \ A \ -B \ Z_{16}) \\ C_{128}^{(b)} = (C \ D \ C \ -D \ Z_{16} \ C \ D \ -C \ D \ Z_{16} \ C \ D \ C \ -D \ Z_{16} \ -C \ -D \ C \ -D \ Z_{16}) \end{array} \right\}$$

(4)

【0045】ここで、式(4)において、 $A=(+ + + -)$ ,  $B=(+ + - +)$ ,  $C=(+ - + +)$ ,  $D=(+ - - +)$ ,  $Z_{16}$ は16個のゼロを意味する。

【0046】次いで、コードの周期が $4 \times 2^i$  ( $i=1,2,3,\dots$ )に対して、 $(0.75+1)$ チップ以下のゼロ相関区間(ZCD)を有するM個のコードから構成される三元ZCDコードセットのTZCSを生成する過程について説明する。

【0047】M個のコードから構成されるTZCSは、M個のコードについて互いに同一なZCDを有し、その区間の長さが $(0.75+1)$ チップ以下の三元コード等のセットを意味する。

$$\{C_N^{(a)}, C_N^{(b)}, T^{\Delta}[C_N^{(a)}], T^{\Delta}[C_N^{(b)}], T^{2\Delta}[C_N^{(a)}], T^{2\Delta}[C_N^{(b)}], \dots, T^{(k-1)\Delta}[C_N^{(a)}], T^{(k-1)\Delta}[C_N^{(b)}], T^{k\Delta}[C_N^{(a)}], T^{k\Delta}[C_N^{(b)}]\}$$

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(5)

【0051】ここで、 $\Delta$ とは、チップシフトの増分(chip-shift increment)であり、 $k$ は与えられたコードに対する最大シフト可能数を意味する。また、 $\Delta$ と $k$ とは、各々正の整数(positive integer)及び負の整数(negative integer)であり、必ず

【0052】

$$M=2(k+1) \text{ and } ZCD = 2\Delta - 1$$

【0055】また、次の表1は、周期32、64、128、256チップに対する三元ZCDコード等の総コード数を示している。

ZCD \ N	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	...	95	...	193
32	12	8	8	4	4	2	2	2	2	2	2	2	-	-	-	-	-	-	-
64	24	16	12	8	8	6	6	6	4	4	4	2	2	2	2	...	-	-	-
128	48	32	24	18	16	12	12	10	8	8	8	6	6	6	6	...	2	-	-
256	96	64	48	38	32	26	24	20	18	16	16	14	12	12	12	...	4	...	2

【0057】図4は、本発明にかかる拡散コードの自己相関特性及び相互相関特性を示す図面である。図4に示したように、128チップの周期を有する一対のコードの

【0040】が発生する。

【0041】ここで、次の式(3)は、 $4 \times 2^2=16$ 周期と13チップのゼロ相関区間を有するコードフェアー $\{C_{16}^{(a)}, C_{16}^{(b)}\}$ の例を示すものである。

【0042】

【数8】

【0044】

【数9】

20

【0048】上記のTZCSは、TZPP(三元ZCDプリファードフェアーコード)の $\{C_N^{(a)}, C_N^{(b)}\}$ を持ってチップシフト動作(chip-shift operation)を行なうことによって生成することができる。

【0049】すなわち、 $T^1$ を時計反方向に1チップずつシフトさせる動作器を、チップシフト動作器とすれば、 $\{C_N^{(a)}, C_N^{(b)}\}$ を用いて、M個のコードから構成される周期MチップのTZCSは、次の式(5)のように生成される。

【0050】

【数10】

【数11】

$$|(k+1)\Delta| \leq \left\lfloor \frac{2N}{8} + 1 \right\rfloor$$

【0053】の条件を満足するべきである。そして、Mと新しく生成されたコードのZCDとの間には、次の式(6)のような関係が成立する。

【0054】

(6)

【0056】

【表1】

50

自己相関の関数値と相互相関の関数値が0になる区間、すなわち、ゼロ相関区間を示しており、128チップの $0.75N+1$ に該当する97チップという局所的な区間内におい

て、自己相関関数のピーク値の周辺サイドローブと二つのコード間の相互相関値が0になることが分かる。

【0058】図5は、本発明に適用される拡散のゼロ相関区間別コード数を準同期符号及び三元ZCDコードと比較したグラフである。

【0059】図5に示したように、ZCDが3チップ以上であれば、上記三元ZCDコードは、QS(OG-r)コード及び三元ZCDコードよりも同一ZCDにおいて極めて多いコード数の確保が可能であるということが分かる。従って、より多いコード数の確保によって、コード分割多重接続(CDMA)通信システムにおいて多い使用者を確保することができ、広いZCDでコード分割多重接続(CDMA)通信システムの準同期運用が可能な許容時間が増加する。

【0060】ここで、本発明により提示された三元拡散コードをCDMAシステムに適用する場合、従来のいかなるバイナリ拡散コードよりも広い準同期運用時間区間を有するようになり、相互間に一定のゼロ相関区間(Zero Correlation Duration; ZCD)を有する拡散コード等の数が他のバイナリ拡散コードより多く生成されるようになる。従って、本発明にかかる三元拡散コードをCDMAシステムの各チャンネルに割り当てる場合、多重化されることはいうまでもなく、コード間のチップ同期をある程度外れても、コード間の直交性(ゼロ相関特性)が一定時間区間の間では連続的に維持されることができる。

【0061】また、本発明に提示した三元拡散コードをセルラー(cellular)システムに適用する場合、セル内逆方向リンク(up-link)ではコード間の同期が要らないCDMAシステムの運用を可能にし、特に、順方向リンク(down-link)に用いる時は、準同期(quasi synchronous)運用区間によって、マルチパットによる影響を減少させることができる。

【0062】また、本発明で提示した三元拡散コードは、広い自己相関ピーク周辺の広い区間において、サイドローブがゼロという特性を用いて、整合フィルター(matched filter)と結びついた初期の同期捕捉用コードで活用することができる。

【0063】また、本発明による三元拡散コードの要素の中から、ゼロに該当する部分は、ハードウェア的に具現する時、スイッチのオフ(Off)動作に代替することができ、逆拡散のための受信部の整合フィルター(Matched filter)具現時には、コード要素のゼロに該当する部分と符合されるタブ係数は、ゼロになるので、その部分の演算がゼロということを鑑みると、ゼロタブ係数と連結された加算器と乗算器の部分は、不必要となるので、全体的な演算量の減少による整合フィルターの低消費電力化が可能である。

【0064】また、本発明による三元コードは、コード発生方法が簡単であって、ハードウェアとしての具現が簡単であり、コード周期の持続的な拡張性が容易である。すなわち、コードの周期Nは、その長さが8チップか

ら2倍の大きさに無限に拡張することができる。前述したような本発明の方法は、プログラムにより具現されて、コンピュータで読み取ることのできる記録媒体(CD-ROM、RAM、ROM、フロッピー(登録商標)ディスク、ハードディスク、光磁気ディスク等)に記憶されることができる。

【0065】尚、本発明は、本実施例に限られるものではない。本発明の趣旨から逸脱しない範囲内で多様な形態で変更実施することが可能である。

【0066】

【発明の効果】上記のように本発明は、三元拡散コードをCDMAシステムに用いる場合、従来のいかなるバイナリ拡散コードよりも広い、準同期運用時間区間を有するようになり、相互間に一定のゼロ相関区間(Zero Correlation Duration; ZCD)を有する拡散コードが、バイナリ拡散コードより多く生成されるようになる。従って、三元拡散コードを、CDMAシステムの各チャンネルの割り当てによる多重化は勿論のこと、コード間のチップ同期をある程度外れても、コード間の直交性(ゼロ相関特性)を一定時間区間の間で、連続的に維持できる効果がある。

【0067】また、本発明は、広いゼロ相関区間(ZCD)を有する三元拡散コードを発生させて、順方向リンクに適用すれば、一定時間区間の間、直交性が連続的に維持されるので、マルチパット現象に対する抵抗力を有するようにし、逆方向リンクに用いられる場合には、コード分割時のセル内の各ユーザー用拡散コードとして割り当てられると共に、マルチプルアクセス(multiple access)によるユーザーチャンネル間の干渉現象を除去させてシステムの効率を高めることができるという効果がある。

【0068】また、本発明は、広い自己相関ピーク周辺の広い区間において、サイドローブがゼロという特性を用いて、整合フィルター(matched filter)と結びついた初期同期捕捉用コードでも活用することができ、コード発生方法が簡単であるので、ハードウェアとして具現が簡単であり、コード周期の持続的な拡張性が容易であるという効果がある。

【図面の簡単な説明】

【図1】本発明にかかるゼロ相関区間を有する三元拡散コード発生過程を説明する一実施例のブロック構成図である。

【図2】図1に示した三元ZCD(Zero Correlation Duration)プリファードフェーズ発生部の一実施例のブロック構成図である。

【図3】図1に示した三元ZCDコードセット発生器の一実施例の詳細ブロック構成図である。

【図4】本発明にかかる拡散コードの自己相関特性及び相互相関特性を示す図である。

【図5】本発明に適用される拡散コードのゼロ相関区間

別のコード数を準同期符号及び三元ZCDコードと比較したグラフである。

【符号の説明】

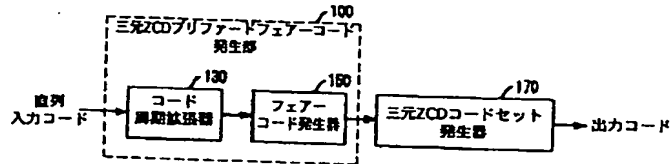
100 三元ZCDプリファードフェアコード発生部

130 コード周期拡張器

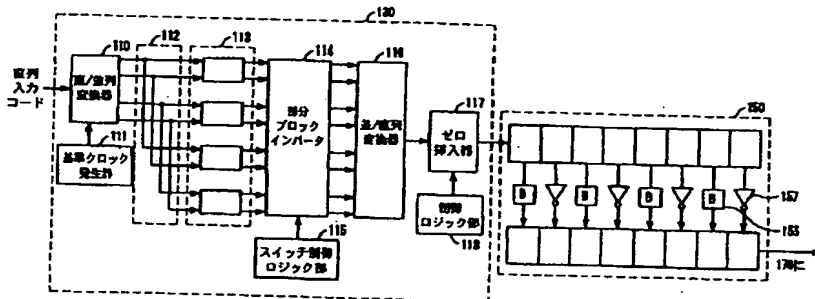
150 フェアコード発生器

170 三元ZCDコードセット発生器

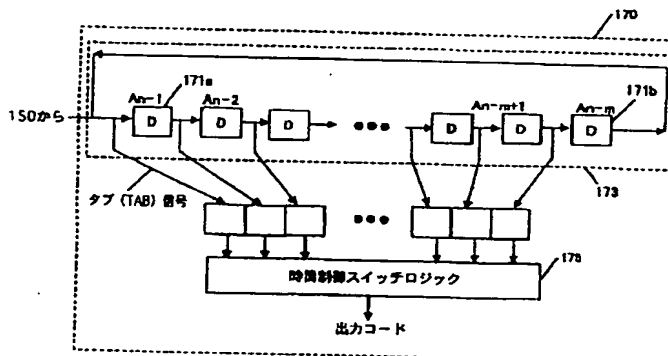
【図 1】



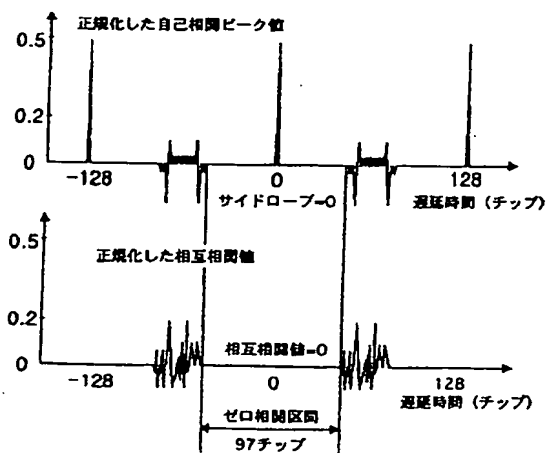
【図 2】



【図 3】



【図 4】



【図5】

